

## CHAPTER 4

### TEST EQUIPMENT AND SAFETY PROCEDURES

#### CHAPTER OBJECTIVES

Upon completion of this chapter, you should be able to:

1. Identify the equipment used in testing retail motor-fuel dispensing systems.
2. Identify procedures for the use and care of test equipment.
3. Describe the proper steps to perform a liquid-measuring accuracy test using a 5-gallon test measure.
4. Recognize the importance of following proper safety practices and procedures when inspecting and testing retail motor-fuel dispensing systems in the field.
5. Understand the purpose and procedures for filling out report forms used by your jurisdiction.

#### Inspection and Test Equipment

The basic equipment required for field examinations of retail motor-fuel dispensing systems includes:

- accurate linear-measuring device, such as a tape measure,
- 5-gallon calibrated test measure, or calibrated test measure as directed by your jurisdiction,
- metal bucket,
- wide-necked metal funnel (plastic is not recommended, as explained in this chapter),
- blank inspection report forms,
- NIST Handbook 44 and copies of other procedures and codes used by your jurisdiction,
- applicable NIST Examination Procedure Outlines,
- price computation tables or hand-held calculator,
- security seals and applicator,
- inspection stickers and tags,
- fire extinguisher,
- hand tools (screwdrivers, pliers, etc.), and
- warning flags or cones.

The linear-measuring device is used to check the length of the dispenser discharge hose: maximum lengths are specified in Handbook 44.

The calibrated test measure is used to test the accuracy of the dispenser's metering device. Procedures for the care and use of this instrument are described below. Refer to Figure 4-1 for typical 5- and 10- gallon test measures.

The funnel is used to return test drafts to the storage tank after volumetric tests have been completed. A metal funnel is necessary because it will provide a ground to the storage tank fill pipe, thereby preventing a buildup of static charge, which could cause a dangerous spark. A plastic funnel will not provide a proper ground and is, therefore, not safe to use.

A metal bucket is used to catch leaks, drain vapor recovery hoods, etc.

Blank inspection report forms allow you to record the test location, applicable specifications and tolerances, inspection and test results, disposition of the device(s), and other necessary information systematically, consistently, and in a readily usable form.

A copy of the applicable NIST Examination Procedure Outline (described in Chapter 5 of this course) or procedures established by your own jurisdiction should be kept handy for reference, as should copies of relevant sections from Handbook 44 and/or other applicable codes.

Price computation tables are needed for checking the dispenser's computer, as well as any remote readouts. If metric units are indicated on the equipment you are testing, metric conversion tables found in Appendix C of NIST Handbook 44 will be required for volumetric tests. A hand-held calculator will perform these functions equally well.

Security seals are used to secure the dispenser's metering device adjustment mechanism against tampering. They are also used to prevent dispensers that have been taken out of service, as a result of testing, from being operated.

Inspection stickers are applied to dispensers to indicate the device has been inspected and found to comply with applicable requirements of NIST Handbook 44 and local jurisdiction requirements. Tags may be used to mark equipment that is required to be removed from service or for other official purposes.

A fire extinguisher is an essential item of safety equipment. Even though the station should have them, the inspector should carry his or her own extinguisher, and keep it readily available at all times.

Hand tools are required for a variety of small tasks, such as opening dispenser cabinets.

Warning flags or cones are positioned around test equipment, dispensers that are being examined, and storage tank fill openings to prevent vehicles and pedestrians from entering work areas.

This list includes all equipment required for inspecting and testing retail motor-fuel devices in accordance with Handbook 44. Other procedures established for your jurisdiction may require additional, or alternative test equipment. For example, "water paste" will be needed if your procedures call for testing storage tanks for water contamination. If "water paste" is used, be certain it is the type that can be used in gasoline and alcohol mixtures if there is any possibility that the fuel contains alcohol.

## The Test Measure

Your test measure is a precision measuring device, capable of providing reliable and extremely accurate readings. It must be traceable to known standards by calibration from a Recognized Metrology Laboratory. That is, a Recognized Metrology Laboratory must verify the accuracy of the test measure before it is put into official use. In order to perform as it is designed to, it must be used and cared for properly.

Test measures come in various standard sizes, but each is designed to measure only one specific amount of liquid. The nominal capacity of the test measure should be the same as the volume of the test draft. Most test procedures for retail motor-fuel devices require drafts of 5 gallons; so a 5-gallon test measure is generally appropriate. Ten-gallon test measures are becoming more popular, especially in jurisdictions where truck mounted provers are in use. Additionally, when testing dispensers used for fueling trucks at high flow rates, a larger test measure or prover may be required (see Chapter 6). Many jurisdictions are using vehicle-mounted test units that include one or more 5-gallon test measures equipped with small holding tanks. These units enable inspectors to run multiple test drafts before emptying the holding tanks into the station's product storage tanks. Equipment availability and the policy of your jurisdiction will determine the test measure size for your use. See Figure 4-1.

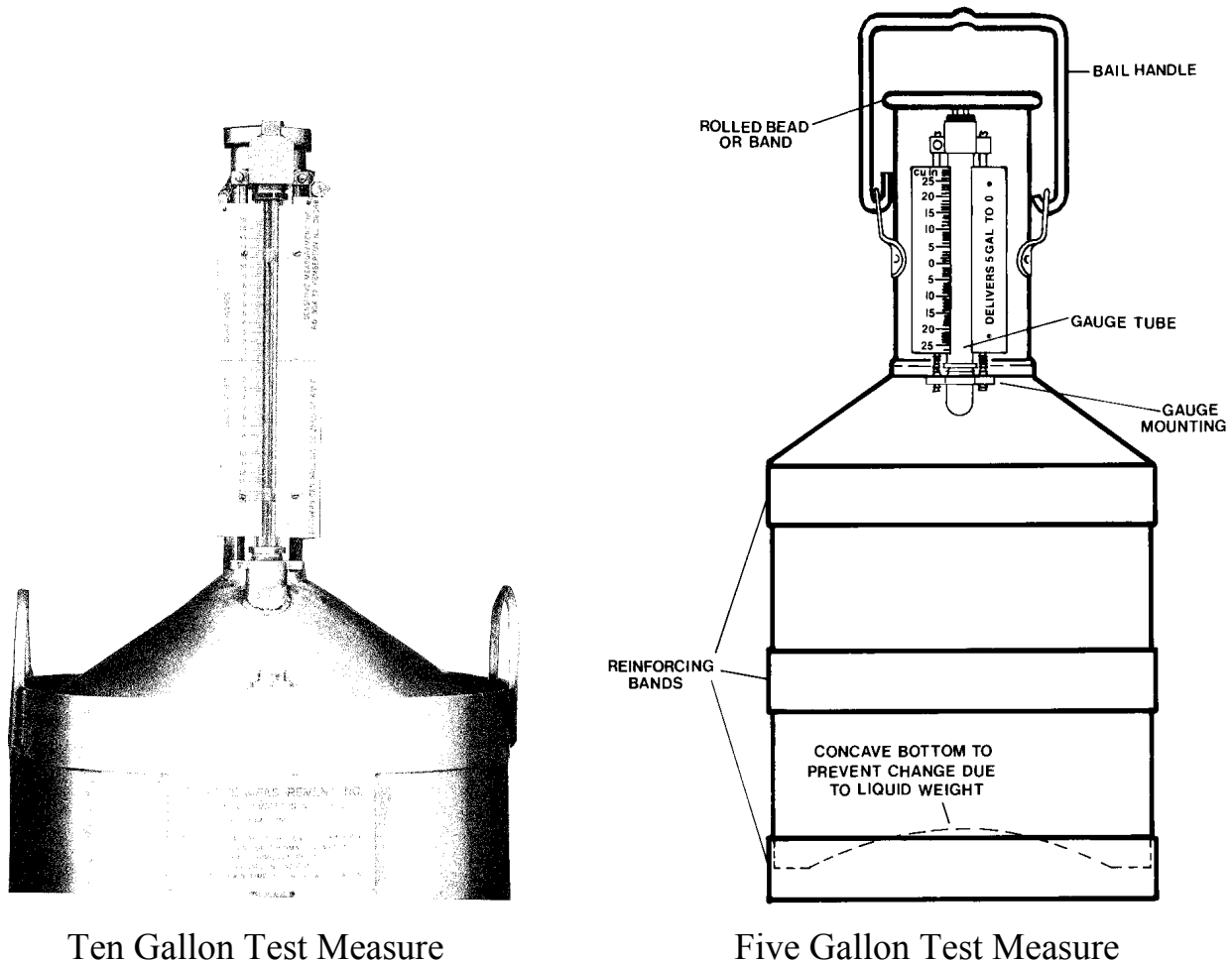


FIGURE 4-1. TYPICAL TEST MEASURES

A measuring gauge is located at the top portion of the test measure. A closer view of the gauge is shown in Figure 4-2. It consists of a glass tube, which extends through an opening into the body of the test measure, and a graduated scale, which is mounted on a bracket that is adjustable for recalibration. As liquid poured into the measure approaches the specified amount, it will rise in the glass tube. The top surface of the liquid acts as an indicator, with readings taken from the graduated scale, as described below.

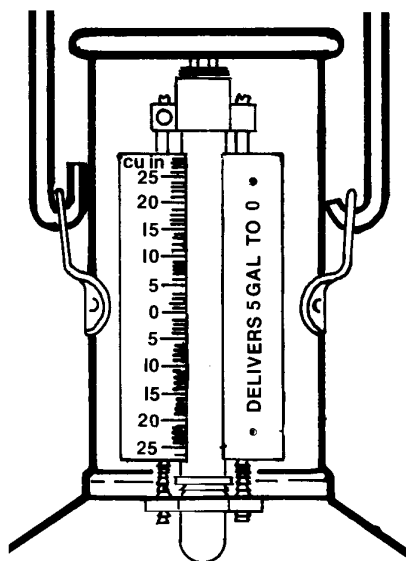


FIGURE 4-2. MEASURING GAUGE

You will notice that the gauge plate says that the measure “delivers” 5 gallons when filled to the zero line. In fact, it will contain somewhat more liquid when filled to that line. The reason for this is that no matter how much care is taken in emptying a test measure, some liquid will cling to the sides of the container. The gauge is calibrated to compensate for this clingage so that tests can be run one after another without having to take time out to thoroughly dry the measure before each test. But that means that if you begin testing with a dry measure you will need to adjust the reading for the first draft to compensate for the absence of clingage. Studies have shown that the approximate amount of clingage that will remain in a 5-gal test measure after it has been properly drained is 1 cubic inch; therefore, this amount should be deducted from the results of the first draft to allow for product clingage.

The following steps should be followed to assure accurate measurements using the test measure:

Step 1      Inspect the inside of the measure for dirt or other foreign material and clean it if necessary. Also inspect the gauge glass, cleaning both inside and outside if necessary.

If the dispenser is equipped for vapor recovery, hold the hose as close as possible to vertical, with no upward bends, with the nozzle held vertically over a bucket, compress the vapor recovery boot, to drain any trapped liquid.

Step 2      Dispense product into the measure until the dispenser indicator reads 5 gallons exactly.

Step 3      Place the measure on a level surface or suspend it by the bail handle so that it hangs vertically. The test measure must be level in order to read accurately, so you may want to check the level by placing a spirit level across the top of the neck, and adjust the position of the test measure as necessary.

Step 4      Read the measurement. The top surface of the liquid in the gauge tube will probably be slightly concave. This curvature is called the meniscus. When viewed from the side, the meniscus may appear to have some thickness, and to be lens-shaped, like the one shown in Figure 4-3. For transparent liquids, like gasoline and diesel fuel, position yourself so that the bottom of the meniscus is exactly at eye level and observe the reading on the gauge scale opposite the bottom of the meniscus.

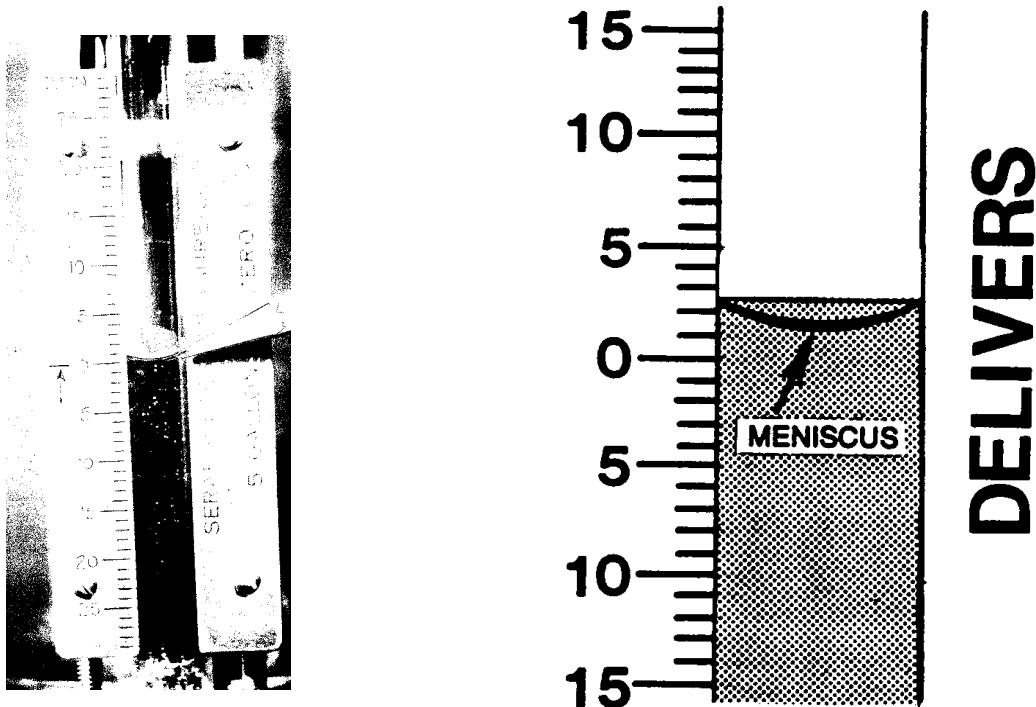


FIGURE 4-3. READING THE MEASURING GAUGE

If not exactly at the zero line, the value shown on the scale will be in “plus” cubic inches (above the zero line) or “minus” cubic inches (below the zero line). If the reading is between gauge graduations, you should always “round off” to the value of the nearest graduation. If the bottom of the meniscus is exactly in the middle of a graduated interval, read the value of the nearest even-numbered graduation. So the example shown in Figure 4-3 would be read as +2 cubic inches, because the bottom of the meniscus is midway between the +1 and +2 graduations on the gauge scale and the lower value (+1) is an odd number.

Step 5 Record the measurement. If the test measure was dry, add 1 cubic inch to the gauge reading to compensate for the absence of clingage.

Step 6 Empty the measure by slowly tilting and pouring product back into the correct storage tank, using a funnel. Empty slowly enough that the main flow of liquid ceases after about 30 seconds. Then, hold the measure at about 10° (see Figure 4-4) from the vertical and continue to drain it for 10 seconds, and turn it upright. Do not shake the measure during this final draining.

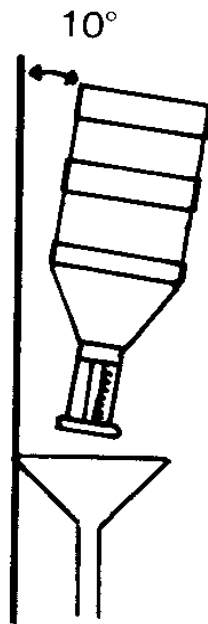


FIGURE 4-4. EMPTYING TEST MEASURE, FINAL STAGE

Repeat Steps 2 through 6 for subsequent drafts.

Care should be taken to avoid denting the test measure or jarring the gauge tube, scale, or mounting bracket. Any such damage may significantly affect the accuracy of the test measure. If damage does occur, the measure should be taken out of service immediately and repaired and recalibrated.

The inside of the measure must be kept clean and free of contaminants. It may be cleaned with detergent and water, but solvents should not be used. Since the container is made of steel, it is subject to rust, so avoid allowing water to remain inside the measure after cleaning.

## Safety

Motor fuels are extremely hazardous substances and should be treated as such at all times. Wherever fuel is present in liquid or in vapor form, there is continual danger of ignition and subsequent fire and/or explosion. This is the greatest safety hazard you will encounter when testing and inspecting fuel-dispensing systems, but it is by no means the only one. As an inspector, you have the responsibility for not only your own safety, but also the safety of station employees, customers, and others in your work area.

Your jurisdiction will have established safety guidelines and procedures. These should be studied carefully and followed to the letter, both in the field and during training exercises. The following is a list of some general safety precautions.

- Do not smoke or permit smoking, flame, or sparks in the vicinity of dispensers or storage tank fill openings or vent pipe.
- Open both sides of dispenser cabinets and permit any fumes trapped inside to dissipate before proceeding with the inspection of the interior of the device.
- Look carefully for leaks and report any found immediately to station supervisory personnel. Your jurisdiction's policies may specify that you not proceed with inspection until the source of the leak is discovered and corrected or that, if necessary, the device must be taken out of service until the leak is repaired. Your instructor will explain these policies to you.
- Eliminate sources of possible static electricity. Do not wear nylon jackets or other fabrics that are likely to produce static. Be sure to use a metal funnel for returning product to storage tanks, and ground the test measure against the metal funnel. Make sure the nozzle is grounded against the test measure when taking a test draft.

Do not use a test measure that has been used for drafts of gasoline to measure diesel fuel until you are certain that all gasoline vapors have dissipated. This practice, called “switch-loading,” is extremely hazardous because diesel fuel is likely to produce a static charge while being dispensed. Sparks from this charge could easily ignite gasoline vapors inside the measure.

There have been incidents where consumers have experienced flash fires when filling gasoline cans in the bed of a pick-up truck with a plastic bed liner. As a further precaution never place the test measure in the bed of a pick-up truck with a plastic liner when drawing your test draft. Always be certain the test measure is grounded and is in contact with the nozzle when taking a test draft.

- Determining which wiring within the hydraulic cabinet of the dispenser that must be enclosed (in a conduit) is not as clear cut as it was several years ago. Many newer dispensers contain “intrinsically safe” wiring within the hydraulic cabinet that is not required to be enclosed. Safety laboratories have

determined that these circuits do not carry enough current to generate a spark, and the wiring is therefore not required to be encased in a conduit. Wiring to the pulser, the pump handle switches, and some selector push buttons in an electronic dispenser, for instance, usually fall within this category.

Generally wiring inside the hydraulic area of the device, which powers higher current components, must be enclosed in a conduit. These would be components like motors, solenoid valves, lighting systems, speakers and the like. The cover of the explosion proof junction box must be in place and securely fastened. Look for any exposed power wiring that originates from the explosion proof junction box and, if found, report it to the station supervisor immediately. Do not proceed with inspection until the condition has been corrected. If necessary, depending on your jurisdiction's policies, you may require that the pump be taken out of service until repaired.

- Do not leave devices activated and unattended. While the system is pressurized, the possibility exists for leakage, which must be observed immediately.
- Always use your metal funnel when returning test drafts to storage tanks to prevent spillage. Ground the test measure against the funnel when pouring the product.
- Avoid inhaling motor-fuel fumes or vapor. Prolonged or frequent inhalation of these substances may be hazardous to your health.
- Wear rubber-soled, treaded shoes to reduce the risk of sparks and provide secure footing on pavement that may be slippery as a result of fuel or lubricant spills.
- Watch out for vehicles moving in or out of the station area. Drivers are generally less attentive when traveling at slow speeds, and are often distracted while looking for a particular product dispenser or vacant pump.

This list of general precautions is not intended to replace specific safety procedures established by your jurisdiction. As part of the requirements for successful completion of this course, you should obtain copies of official safety guidelines and procedures, study and review them with your instructor, and practice them thoroughly.

## **Report Forms**

Every official action you take as an inspector must be recorded, and reports of that activity are used in different ways. For the examination of retail motor-fuel dispensers, you will need to keep records of:

- the dispensers examined,
- the findings in that examination,
- the decision on acceptability of the dispenser, and
- action taken as a result of that decision.

The Uniform Weights and Measures Law in NIST Handbook 130, which has been adopted by most States, requires that adequate records be maintained; but only infrequently, if at all, do these statutes describe the details of the records.



A good report form should:

- Be complete enough, legible, and in a suitable form so that it is the primary record; that is, it should not be necessary for someone to copy the report information onto other records.
- Provide a detailed record of the work performed by the inspector. In the case of examination of retail motor-fuel dispensers, it should contain space for all the information you will gather when you follow the Examination Procedure Outline.
- Give the owner or operator of the device a clear understanding of the compliance or noncompliance of his or her equipment and the official action taken as a result of the test.
- Serve as a guide to the serviceperson in the repair of a rejected device.
- Provide an historical record of individual devices and establishments, with necessary data from which statistics may be derived.
- Be a simple design, easy to use, and easy to understand.

At this time, every jurisdiction has different report forms and systems unique to that jurisdiction. Your instructor will explain the use of the report forms used in your jurisdiction.

For comparison, Figures 4-5 and 4-6 on the following pages are representative sample report forms. These have been selected from the many different types of forms in use at this time.

## **SUMMARY**

The weights and measures official takes a variety of tools into the field. Among these are the tools and instruments that are used to test the device, the report forms that facilitate test procedures and administrative procedures and are used to document the results of the inspection and test, and the knowledge that is required to make practical and effective judgments under various conditions. The inspector must know how to use and maintain all of these tools. A thorough and confident knowledge of safety practices and the conditions that may necessitate their application is also essential, since retail motor-fuel dispensers are used to measure and dispense hazardous substances.

1 - SEND TO DIVISION OF STANDARDS

STATE OF FLORIDA  
DEPARTMENT OF AGRICULTURE  
AND CONSUMER SERVICES  
PUMP INSPECTION REPORT

| DATE OF INSPECTION |     |      |
|--------------------|-----|------|
| MO.                | DAY | YEAR |
|                    |     |      |



Bob Crawford  
Commissioner

STATION OR FACILITY NO. \_\_\_\_\_ INSP. CODE \_\_\_\_\_ COUNTY \_\_\_\_\_ LOCATION ADDRESS \_\_\_\_\_ LOCATION CITY AND STATE \_\_\_\_\_ MAILING ZIP CODE \_\_\_\_\_

LOCATION \_\_\_\_\_ MAILING CITY AND STATE \_\_\_\_\_ MAILING ZIP CODE \_\_\_\_\_

STATION OR STORE NAME \_\_\_\_\_ OWNER OR MANAGER \_\_\_\_\_

[illegible][illegible]

| ATTRIBUTE CODES:   | 1=NOZZLE CHECK VALVE | 2=INDICATOR | 3=IMPROPERLY LABELED | 4=INTERLOCK | 5=COMPUTER | 6=AIR ELIMINATOR | 7=GLASS | 8=METER NOT SEALED | 9=LEAK | 0=OTHER |
|--|----------------------|-------------|----------------------|-------------|------------|------------------|---------|--------------------|--------|---------|
| <p>THE FOLLOWING PUMPS WERE FOUND NOT TO COMPLY WITH THE GASOLINE INSPECTION LAW:</p> <p>ENTER CONDEMNED OR TIME</p> |                      |             |                      |             |            |                  |         |                    |        |         |

[illegible][illegible][illegible][illegible][illegible]

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|  |           |        |                     |
|--|-----------|--------|---------------------|
| PERSON IN CHARGE AT TIME OF INSPECTION   | INSPECTOR | NUMBER | PHONE NUMBER        |
|  |           |        | <i>Bob Crawford</i> |
| BY AUTHORIZED MECHANIC OR OTHER RESPONSIBLE PARTY — PHONE NUMBER — MECHANIC CERTIFICATE NO. (REQUIRED) |           |        |                     |
| BOB CRAWFORD   |           |        |                     |

|     |     |      |
|-----|-----|------|
| MO. | DAY | YEAR |
|     |     |      |

PUMPS WERE CORRECTED ON

|   |   |   |   |
|---|---|---|---|
| : | : | : | : |
|---|---|---|---|

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AS SOON AS CORRECTIONS ARE MADE SIGN THIS NOTICE AND RETURN TO: **DIVISION OF STANDARDS, 3125 CONNER BLVD., TALLAHASSEE, FLORIDA 32399-1650**

FIGURE 4-5. SAMPLE REPORT FORM



Maryland Department Of Agriculture  
Weights and Measures Section  
50 Harry S. Truman Parkway  
Annapolis, Maryland 21401  
Telephone (410) 841-5790

PAGE \_\_\_\_\_ OF \_\_\_\_\_

DATE OF INSPECTION \_\_\_\_\_

NO. OF METERS \_\_\_\_\_

SMALL LIQUID MEASURING DEVICE REPORT

REPORT NO. \_\_\_\_\_

|               |  |           |  |                   |  |                           |  |
|---------------|--|-----------|--|-------------------|--|---------------------------|--|
| FIRM _____    |  |           |  | ACCOUNT NO. _____ |  | PHONE NO. _____           |  |
| ADDRESS _____ |  |           |  | COUNTY _____      |  | TIME IN/TIME OUT _____    |  |
| CITY _____    |  | ZIP _____ |  | OWNER/MGR. _____  |  | DATE LAST INSPECTED _____ |  |

I acknowledge receipt of this report and certify that I understand the violations or instructions described herein.

RECEIPT ACKNOWLEDGED \_\_\_\_\_

INSPECTOR \_\_\_\_\_

| Device No. | Make/Model | Serial No. | Violation Key | Test | Prover Reading | Action Taken |      |       | Totalizer  |             | Total Gal./L | Product |
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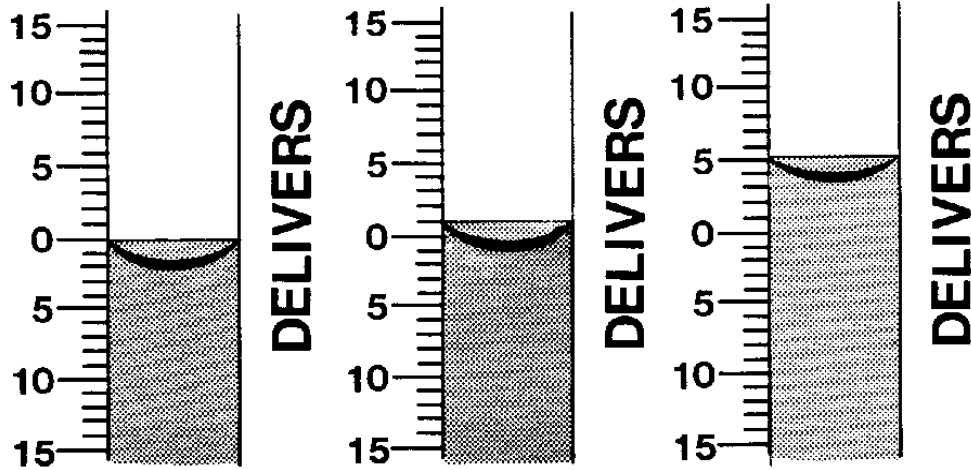
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## REVIEW QUESTIONS AND ANSWERS

Circle the correct answer(s) for each question or respond as otherwise indicated. If a multiple choice question does not specifically ask for “all correct answers,” it may be assumed that only one of the answers listed is correct.

1. Describe briefly what the following items of test equipment are used for:
  - a. linear-measuring device \_\_\_\_\_  
\_\_\_\_\_
  - b. price computation tables \_\_\_\_\_  
\_\_\_\_\_
  - c. security seals \_\_\_\_\_  
\_\_\_\_\_
2. A metal funnel is used:
  - a. to fill the test measure.
  - b. to return product to storage tanks after testing.
  - c. to remove water from storage tanks.
  - d. (a) and (b) only.
  - e. all of the above.
3. True or False: A 10-gallon test measure can be used to test 5-gallon drafts.
4. Test measures are calibrated to be used “wet” in order:
  - a. to compensate for evaporation of test liquid during dispensing and measurement.
  - b. to lubricate the inside of the container so that air bubbles will not form and cling to the sides.
  - c. to compensate for test liquid remaining in the measure after a previous draft has been emptied.
  - d. to assure that contaminants have been flushed from the inside of the container before use.
  - e. all of the above.

5. When emptying a test measure, the measure should be held at an angle of  $10^\circ$  from the vertical for 10 seconds until/after the main flow has ceased. (Cross out incorrect answer.)
6. Record values for the following test gauge readings:



a. \_\_\_\_\_ b. \_\_\_\_\_ c. \_\_\_\_\_

7. Where are specific safety guidelines and procedures for your jurisdiction located? Give title and/or description of document and tell where copies can be obtained.